PTO 99-4505

Spanish Article
Delgado, et al.

ANALYSIS OF THE DIALLELIC CROSSING OF SIX INDEHISCENT AND TWO DEHISCENT VARIETIES OF SESAME *Sesamum indicum* L.
[Analisis del Cruzamiento Dialelico de Seis Variedades Indehiscentes y Dos Dehisentes de Ajonjoli *Sesamum indicum* L.]

Nelly Delgado, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D. C. August 1999

Translated by: FLS, Inc.

Translated title : ANALYSIS OF THE DIALLELIC CROSSING OF SIX INDEHISCENT AND TWO DEHISCENT VARIETIES OF SESAME *Sesamum indicum* L.[1)]

Spanish title : Analisis del Cruzamiento Dialelico de Seis Variedades Indehiscentes y Dos Dehisentes de Ajonjoli *Sesamum indicum* L.[1)]

Authors : Delgado, Nelly*; Layrisse, Alfredo**

Author affiliation: *DESTECSA S.A. Turmero, Aragua State, Venezuela;
**Central University of Venezuela, Department of Agronomy, Maracay, Venezuela

Source : *AGRONOMIA TROPICAL*
Vol. **42**, Numbers 3 - 4
1992
Pages 191-209

[1)]This study was produced as part of the master's thesis of the first author, in the Department of Agronomy

ANALYSIS OF THE DIALLELIC CROSSING OF SIX INDEHISCENT AND TWO DEHISCENT VARIETIES OF SESAME /191*

Nelly Delgado and Alfredo Layrisse

One of the principal causes of the low yield of sesame is the loss of a high percentage of the seed in the harvest as a consequence of the dehiscence of the fruit. There is in this study an exploration of the possibility of increasing the yield of the indehiscent mutant, until now of little commercial utility, by taking advantage of the hybrid vigor in crosses between indehiscent varieties. With this goal in mind, a complete diallel was evaluated among eight varieties of sesame, six of them indehiscent, in Guayabita, Edo. Aragua, in 1988. A partial diallel (8 x 5) was planted in the same locality in 1989. It was possible to detect a notable hybrid vigor in the harvest. Larger values for heterosis were found in the cross between indehiscent varieties, but the hybrids with the best absolute yield resulted from certain combinations of the indehiscent x dehiscent varieties. The heterosis and high specific combinatorial capacity of some indehiscent hybrid varieties, with a yield as large or larger than that of the most common commercial varieties, indicate that this would be a promising approach in a program for the genetic improvement of sesame, for the purpose of overcoming the loss of seed in the harvest without

---

*Numbers in the margin indicate pagination in the foreign text.

sacrificing productivity.

INTRODUCTION

/192

One of the principal causes of the low yield of sesame on the world level, especially where harvesting is mechanized, as in Venezuela, is constituted by the loss of a high percentage of the seed as a result of the dehiscence of the fruit (8).

The most promising way to overcome this limitation appears to be the utilization of the indehiscent mutant, which is recessive (6). But this mutant presents collateral effects, such as the bunching of the leaves, enascence in leaves and flowers, low fertility, curvature in the stalk; some of these drastically reduce the yield, preventing its commercial use.

In this study, there is an exploration of the possibility of improving the yield of the indehiscent varieties by taking advantage of the vigor which could be produced by crossing the indehiscent genotypes. It is possible that by this means hybrids could be obtained with capsules which do not open on maturity and with yields similar to those commercial varieties most commonly used.

Various experiments where carried out with sesame which exhibit the manifestation of heterosis in the F_1 of the cross between dehiscent materials (1, 3, 7, 9, 11, 12, 13, 14, 15). Only NAFIE (10) indicates the presence of hybrid vigor on crossing indehiscent materials.

By means of the present investigation, an attempt is made to evaluate not only the presence of heterosis in the cross between

indehiscent varieties and its behavior in relation to commercial controls, but also the importance of the effects of the general and specific combinatorial capacity via the analysis of a diallelic cross between eight varieties of sesame, six of them indehiscent and two dehiscent.

MATERIALS AND METHODS

The varieties selected as fathers are the following: a) 'UCR-82-202' and 'Fonalí III', which have a very conspicuous manifestation of the bunching of the leaves and of enascence in leaves and flowers, characteristics associated with indehiscence; 'UCR-82-13', 'Fonalí IV', '452(ASPA)' and 'Morada indehiscente' [Indehiscent Violet] with an intermediate manifestation of those characters associated with indehiscence and with capsules slightly open at maturity; c) 'Inamar' and 'Aceitera' [Oil Jar], which are commercially cultivated deshiscent varieties.

From this point onward, those varieties included in the present study shall be identified in the following manner: 452 ASPA: 1; UCR 82-202: 2; Morada id.: 3; Fonalí IV: 4; Fonalí III: 5; Aceitera: 6; Inamar: 7 and UCR 82-13: 8.

These materials were planted in August, 1987, to make the crossing simple, without reciprocals among any of them, thus resulting in 28 simple hybrids.

The 28 hybrids of F_1 and the fathers were planted in the /193
MAVESA experimental parcel in Guayabita, Edo. Aragua, Venezuela, in the period of February-June, 1988 and 1989. The second of these trials was then carried out to establish, unsuccessfully,

two experiments in Turén, Edo. Portuguesa, a zone where sesame is planted commercially.

The tests were carried out according to a random design with complete blocks, with a first run of 36 treatments and a second of 28 treatments, both with three repetitions. The number of treatments in the second run was lower due to the total loss of the seed of some of the hybrids in the sterile plantings of Portuguesa. Each parcel was formed by a row, three meters wide, with an average of 20 plants per meter. A row without planting was left between parcels to eliminate the effect of competition between distinct cultivations.

The measurements were made: a) days until florescence, when 50% of the plants in the parcel exhibited flowers (DF); b) height of the first node with fruit, in centimeters (AF); c) height of the plant in centimeters (AP); d) number of fruits per plant (NFP); e) average yield of seed from 10 fruits, taken from the middle third of each plant measured (R10F); f) average weight of 10 seeds, taken at random from the total produced in the parcel (PMS); g) yield of 10 plants in grams of seed per parcel (RP).

Observations b, c, d, e were made on ten plants, with complete competition between each parcel.

The variance analysis of the design with complete blocks was carried out at random with the data of F_1 for the two periods separately, by breaking down the source of genotypic variation into the following effects: fathers, crosses and father vs. crosses.

The plan for the analysis of variance is the following:

F.V.	g.1 (1)	g.2 (2)	C.M.	C.M.E.
Repetitions	2	2		
Genotypes	35	27	M_2	$\sigma^2E + r(a - 1)\Sigma V_i^2$*
Fathers (P)	7	7	M_{21}	
Crosses (C)	27	19	M_{22}	
P vs. C	1	1	M_{23}	
Experimental error	70	54	M_1	σ^2E
Total	107	83		

(1) Test, 1988 (2) Test, 1989
*r = 3; a = 36 (first test); a = 28 (2nd test).

For the first period, the estimations of the effects of /194
general combinatorial capacity (CCG) and of specific combinatorial capacity (CCE) were obtained by means of diallelic analysis of the data using method 2, model 1 of GRIFFING (4), since they included the fathers and the crosses without reciprocals, considering the varieties as a fixed sample.

The ANAVAR plan was the following:

F.V.	g.1.	C.M.E.
CCG	7	$\sigma^2E + 10/7\ \Sigma g_i^2$
CCE	28	$\sigma^2E + 2/56\ \Sigma\Sigma S^2ij$
Error	70	σ^2E

In the second period, due to the loss of the seed from the hybrids during the planting of the two sterile tests in Turén Edo. Portuguesa, it was necessary to plant a partial diallel in Guayabita, which included 20 hybrids and 8 fathers.

The materials included in this test were chosen according to the methodology of KEMPTHORNE and CURNOW (5). Determined for that purpose was a value of $k = (p + 1 - s)/2$, where p is the number of fathers of the diallel and s is the number of crosses carried out with each father. In this case, $p = 8$ and $s = 5$, for which $k = 2$, the hybrids being included in the following partial diallels:

1 x 2	2 x 4	3 x 5	4 x 6	5 x 7	6 x 8
1 x 4	2 x 5	3 x 6	4 x 7	5 x 8	
1 x 5	2 x 6	3 x 7	4 x 8		
1 x 6	2 x 7	3 x 8			
1 x 7	2 x 8				

The plan for the variance analysis was kept equal to the complete diallel, by varying only those degrees of freedom of each source of variation relative to the number of materials included in the analysis.

Heterosis was varied by the deviation of F_1 relative to the average of the fathers. To determine significant values for heterosis, a t test was carried out as follows:

$$t = \frac{F_1 - (P_1 + P_2)/2}{(3\sigma^2 E/2r)^1/2}$$

Heterosis was also evaluated as the deviation of F_1 relative to the best of the fathers of the cross.

RESULTS AND DISCUSSION

Variance analysis of fathers and crosses

The genotypes were significantly different for all the varieties studied in both tests (complete diallel 8 x 8 and partial diallel 8 x 5) according to Tables 1 and 2, respectively. In the complete diallel, there were different levels of significance between fathers and between crosses in all the variables, whereas in the partial diallel only PMS and R10P were not significant for these sources of variation. The fathers vs. crosses contrast was significant in variables PMS, R10F, R10P and RP in the 8 x 8 diallel, and in AF, R10F, R10P and RP in the partial diallel. It can be observed in Table 3 that, in the yield variables, the crosses were on the average superior to the fathers in a conspicuous manner, especially in the partial diallel.

Mean tests and heterosis

Tables 4 and 5 show the tests of means according to Tukey and the significant values for heterosis above the mean for the fathers (h_1), and above the best father (h_2) for the variable R10P in the 8 x 8 and 8 x 5 diallels, respectively. The formation of numerous groups took place in the 8 x 8 diallel, distinguishing the indehiscent hybrid Fonalí IV x UCR 82-13, which was superior to both commercial varieties used as controls and various ones among the hybrids between dehiscent and indehiscent. The indehiscent Morada id hybrids with 452 (ASPA, UCR 82-202, UCR 82-13 and Fonalí III were situated in the same

group of averages as the commercial varieties. All these hybrids displayed significant heterosis above the average of the fathers and above the best of the fathers, reaching values as high as 339%.

In the 8 x 5 diallel, where there were no significant differences between crosses for the variable R10P, only three groups were formed. The hybrids between the indehiscent varieties Morada id x Fonalí III, UCE 82-202 x Fonalí IV and Fonalí IV x UCR 82-13 were located in the same group of means as the commercial varieties, but with absolute yields that were somewhat greater. Only the indehiscent hybrid Morada id x Fonalí III presented elevated heterosis values. It is necessary to point out that all the crosses of Inamar included in the diallel occupied the first places and displayed high heterosis quite superior to the commercial varieties.

As for the yield per parcel (RP), the hybrids of the dehiscent type occupied the first positions, followed by the commercial varieties and certain hybrids between indehiscent varieties (Tables 6 and 7). The worst yields corresponded, as anticipated, to the indehiscent varieties and certain of their hybrids. In the 8 x 8 diallel, the prominent indehiscent hybrids

TABLE 1: Averages of the variance analyses of fathers and crosses for those variables analyses in the 8 x 8 diallel. Year 1988.

F.V.	gl	AP	AF	DF	NFP	PMS	R10F	R10P	RP
Rep	2	168,30	9,13	13,87**	9,43	0,03	0,12	113,71	54 606,78
Genotypes*	35	2 010,92**	1 085,62**	35,08**	604,49**	0,34**	0,76**	4 088,16**	111 363,64**
Fathers (P)	7	2 693,08**	1 325,80**	64,93**	730,55*	0,75**	1,03**	3 151,55**	94 428,65**
Crosses (C)	27	1 906,94**	1 062,49**	28,26**	579,12**	0,22**	4,41**	3 344,17**	94 270,80**
P vs. C	1	38,66	12,52	10,42	409,80	0,78**	8,48**	30 745,58**	691 002,09**
Error	68	106,00	19,23	1,85	259,40	0,02	0,09	959,06	18 502,38
CV (%)		7,41	9,37	3,24	23,24	4,06	13,43	31,00	30,59

* $P < 0.05$ ** $P < 0.01$

AP=Height of plants
AF=Height to the first node with fruit
DE=Days until flowering
NFP=Number of fruit per plant
PMS=Weight of one thousand seeds
R10F=Yield of seed from 10 plants from 10 fruits
R10P=Yield of seed
RP = Yield per parcel

TABLE 2: Averages of the variance analyses of fathers and crosses for those variables analyses in the 8 x 5 diallel. year 1989.

F.V.	gl	AP	AF	DF	NFP	PMS	R10F	R10P	RP
Rep	2	4 325,37**	839,61**	17,33**	1 179,36**	0,0563	0,112	1 746,58*	11 987,72**
Genotypes	27	624,62**	528,54**	45,31**	91,38*	0,2212**	0,4942**	532,60*	17 578,31**
Fathers (P)	7	1 037,00**	1 811,68**	65,47**	126,67*	0,5203**	0,8650**	335,50	12 292,47*
Crosses (C)	19	502,00**	438,56**	40,23**	83,07*	0,1223	0,2756**	460,59	15 875,09**
P vs. C	1	67,66	254,65*	0,90	2,10	0,0509	2,0509**	3 280,48**	86 925,03**
Error	54	61,48	38,06	1,86	40,68	0,0711	0,0746	279,15	4 701,38
CV (%)	7,33	15,81	4,07	14,46	8,18	14,52	31,00	29,59	

* $P < 0.05$ ** $P < 0.01$

AP=Height of plants
AF=Height to the first node with fruit
DE=Days until flowering
NFP=Number of fruit per plant
PMS=Weight of one thousand seeds
R10F=Yield of seed from 10 fruits
R10P=Yield of seed from 10 plants
RP=Yield per parcel

TABLE 3: **Comparison of the average values for fathers and crosses in both diallelic tests, for those characteristics in which the fathers vs. crosses contrast was significant.**

	8 x 8 Diallel			8 x 5 Diallel		
	$\bar{x}p$	$\bar{x}c$	$(\bar{x}c/\bar{x}p)-1$	$\bar{x}p$	$\bar{x}c$	$(\bar{x}c/\bar{x}p)-1$
AF	-	-	-	36.27	79.63	1.19
PMS	3.41	3.62	0.06	-	-	-
R10F	1.71	2.39	0.40	1.63	3.96	1.42
R10F	68.44	109.19	0.60	44.25	116.16	1.62
RP	295.71	485.85	0.64	180.87	504.16	1.78
$\bar{\bar{x}}$			0.43			1.50

$\bar{x}p$ = Average for all fathers

$\bar{x}c$ = Average for all crosses

TABLE 4: Test of means according to Tukey and significant values of heterosis (in percentages) for the yield variable of 10 plants (R10P) and in the 8 x 8 diallel. /199

Genotype	Mean (g)	Group	h_1	h_2
7 x 8	174.00	A	74^{**}	63^{**}
2 x 6	166.33	AB	77^{**}	59^{**}
4 x 8	151.07	ABCD	106^{**}	61^{**}
4 x 6	139.50	ABCD	78^{**}	
5 x 7	131.67	ABCD	80^{**}	
1 x 6	135.00	ABCDE	98^{**}	
5 x 6	131.00	ABCDE	73^{**}	
1 x 3	129.59	ABCDEF	339^{**}	305^{**}
4 x 7	128.93	ABCDEF	62^{**}	
2 x 7	128.19	ABCDEF		
2 x 3	120.81	ABCDEF		
3 x 7	115.67	ABCDEF		
3 x 6	114.63	ABCDEF	74^{*}	
3 x 8	112.00	ABCDEF	85^{*}	
6 x 8	111.63	ABCDEF		
1 x 7	109.19	ABCDEF		
3 x 5	108.15	ABCDEF	191^{**}	130^{**}
7	106.67	ABCDEF		
6	104.33	ABCDEF		
6 x 7	104.33	ABCDEF		
2 x 4	103.67	ABCDEF		
1 x 4	101.52	ABCDEF	104^{**}	93^{**}
8	93.81	ABCDEF		
2 x 8	90.67	ABCDEF		
3 x 4	84.00	ABCDEF	110^{**}	
2	83.74	ABCDEF		
2 x 5	75.67	ABCDEF		
5 x 8	69.00	BCDEF		
4 x 5	65.00	BCDEF		
1 x 2	59.33	CDEF		
4	52.67	DEF		
5	47.00	DEF		
1 x 8	46.33	DEF		
1 x 5	43.33	DEF		

Continued ./...

Genotype	Mean (g)	Group	h_1	h_2
1	32.00	EF		
3	27.33	F		

MDS = 101.74

1 = 452 ASPA
2 = UCR 82-202
3 = Morada id
4 = Fonalí IV
5 = Fonalí III
6 = Aceitera
7 = Inamar
8 = UCR 82-13

h_1 = heterosis in excess of the average of the fathers
h_2 = heterosis in excess of the best father

TABLE 5: Test of means according to Tukey and significant values of heterosis (in percentages) for the yield variable of 10 plants (R10P) and in the 8 x 5 diallel.

Genotype	Mean (g)	Group	h_1	h_2
2 x 7	85.67	A	75^{**}	61^{**}
1 x 7	75.00	AB	62^{**}	56^{**}
5 x 7	70.33	AB	74^{**}	57^{**}
4 x 7	66.67	AB	77^{**}	49^{**}
3 x 7	66.67	AB	77^{**}	49^{**}
6 x 8	63.33	AB		
3 x 6	61.67	AB		
3 x 5	61.33	AB	84^{**}	69^{**}
2 x 4	61.33	AB		
1 x 6	60.00	AB		
6	58.00	AB		
4 x 8	58.00	AB		
1 x 5	56.67	AB		
4 x 6	56.67	AB		
2 x 5	55.33	AB		
3 x 8	53.33	AB		
2	53.33	AB		

Continued ./...

Genotype	Mean (g)	Group	h_1	h_2
8	52.33	AB		
2 x 8	48.67	AB		
1	48.00	AB		
7	44.67	AB		
2 x 6	42.67	AB		
1 x 4	42.67	AB		
1 x 3	42.33	AB		
5	36.33	AB		
5 x 8	32.33	AB		
3	30.67	B		
4	30.67	B		

MDS = 54.04

1 = 452 ASPA
2 = UCR 82-202
3 = Morada id
4 = Fonalí IV
5 = Fonalí III
6 = Aceitera
7 = Inamar
8 = UCR 82-13

h_1 = heterosis in excess of the average of the fathers
h_2 = heterosis in excess of the best father

TABLE 6: Test of means according to Tukey and significant values of heterosis (in percentages) for the yield per parcel (RP) and in the 8 x 8 diallel.

Genotype	Mean (g)	Group	h_1	h_2
7 x 8	888.88	A	100^{**}	60^{**}
4 x 7	733.90	AB	99^{**}	37^{**}
6 x 7	688.60	ABC		
2 x 6	686.60	ABC	67^{**}	
3 x 6	670.70	ABC	112^{**}	
3 x 7	652.00	ABC	104^{**}	
4 x 6	649.90	ABCD	73^{**}	
5 x 7	629.70	ABCD	53^{**}	
1 x 6	628.00	ABCD	98^{**}	

Continued ./...

Genotype	Mean (g)	Group	h_1	h_2
5 x 6	619.80	ABCD	52^{**}	
4 x 8	582.20	ABCD	120^{**}	76^{**}
6 X 8	558.60	ABCD		
7	555.60	ABCD		
2 x 7	548.00	ABCD		
6	536.80	ABCDE		
3 x 5	426.70	BCDE	139^{**}	
1 x 7	408.90	BCDE		
2 x 8	393.80	BCDE		
2 x 3	393.50	BCDE	111^{**}	
4 x 5	358.50	BCDE		
3 x 8	386.50	BCDE		
1 x 4	355.40	BCDE	139^{**}	
3 x 4	347.20	BCDE	145^{**}	
2 x 4	338.50	BCDE		
8	331.70	BCDE		
1 x 3	330.60	BCDE		
2 x 5	314.00	BCDE		
2	287.20	BCDE		
1 x 2	273.60	CDE		
5 x 3	273.60	CDE		
5	272.00	CDE		
1 x 8	263.20	CDE		
4	199.30	DE		
1 x 5	182.70	DE		
1	97.90	E		
3	85.20	E		

MDS = 446.86

1 = 452 ASPA
2 = UCR 82-202
3 = Morada id
4 = Fonalí IV
5 = Fonalí III
6 = Aceitera
7 = Inamar
8 = UCR 82-13

h_1 = heterosis in excess of the average of the fathers
h_2 = heterosis in excess of the best father

TABLE 7: Test of means according to Tukey and significant values of heterosis (in percentages) for the yield per parcel (RP) and in the 8 x 8 diallel. /203

Genotype	Mean (g)	Group	h_1	h_2
2 x 7	377.67	A	86**	68**
5 x 7	359.33	A	123**	60**
3 x 7	327.00	AB	111**	46**
4 x 7	325.67	AB	54**	46**
3 x 6	325.33	AB	81**	
2 x 6	316.00	ABC		
4 x 6	297.67	ABCD		
6 x 8	283.00	ABCD		
6	274.00	ABCD		
1 x 7	268.00	ABCD		
3 x 8	250.67	ABCD		
1 x 5	238.30	ABCD		
1 x 6	225.00	ABCD		
7	224.67	ABCD		
4 x 8	221.67	ABCD		
8	217.00	ABCD		
4	200.00	ABCD		
2 x 4	200.00	ABCD		
1 x 3	199.33	ABCD		
1 x 4	195.67	ABCD		
2	182.33	ABCD		
3 x 5	182.00	ABCD	100**	88**
2 x 5	177.33	ABCD		
1	167.00	ABCD		
2 x 8	163.67	ABCD		
5 x 8	108.33	BCD		
5	97.00	CD		
3	85.00	D		

MDS = 221.80

1 = 452 ASPA
2 = UCR 82-202
3 = Morada id
4 = Fonalí IV
5 = Fonalí III
6 = Aceitera
7 = Inamar
8 = UCR 82-13

h_1 = heterosis in excess of the average of the fathers
h_2 = heterosis in excess of the best father

were Fonalí IV x UCR 82-13, Morada id x Fonalí III and in the 8 x 5 diallel, Morada id x UCR 82-13 and 452 ASPA x Fonalí III, whose behavior was found to be similar to that of the commercial varieties. In the 8 x 8 diallel, there were six hybrids which showed significant heterosis, although only the two mentioned above where found to behavior in a manner similar to the controls. In the 8 x 5 diallel, only on indehiscent hybrid exhibited significant heterosis, but its yield is not of interest for the purposes sought. /204

There was in both tests a considerable number of hybrids of the indehiscent x dehiscent type, which occupied the first places in yield per parcel and showed significant heterosis. Although the original purpose of this study was not to identify conspicuous dehiscent hybrid combinations, it is however possible to indicate certain crosses of Inamar with varieties having indehiscent capsules which could serve as a point of departure in a program for the development of hybrids where there are no restrictions relative to the opening of the capsule.

Preference was given to the designing of squares where the heterosis values appear together with the tests of means for the purpose of visualizing those combinations which not only exhibit heterosis, but do so with yields comparable to the commercial controls.

It is necessary to indicate that the behavior of the indehiscent hybrids is not so pronounced, when the yield per parcel is considered in terms of the yield from 10 plants.

Nevertheless, in the case of both yield variables, indehiscent hybrids appear to have a yield similar to that of the commercial varieties. This suggests that the commercial utilization of the indehiscence of indehiscent varieties would be advantageous. One of the combinations which should be tested is that of Fonalí x UCR 82-13.

Variance analysis of the 8 x 8 and 8 x 5 diallels

In the variance analysis of the 8 x 8 diallel, planted in 1988, significant differences were detected for all the variables relating to combinatorial capacity (CCG) and specific combinatorial capacity (CCE)(Table 8). Significant differences were found in the other diallel for the variables AP, DF, R10F and RP (Table 9). In both tests, those additive genetic effects associated with the CCG as well as the nonadditive effects (dominance and epistasis), associated with the CCF, were of importance particularly for the yield.

Estimates of the effects of combinatorial capacity

Presented in Tables 10 and 11 are the effects for CCG for all the variables in both tests. In general, it can be noted that the indehiscent fathers

TABLE 8: Averages of the variance analysis of the 8 x 8 diallel. 1988.

F.V.	gl	AP	AF	DF	NFP	PMS	R10F	R10P	RP
CCG	7	9,081.75**	4,951.30**	151.24**	1,118.92**	1.45*	1.69**	7,345.64**	348,251.06**
CCE	28	244.58*	140.07**	6.03**	475.81**	0.07**	0.54**	3,272.53**	52,688.26**
Error	70	103.14	18.78	1.80	252.04	0.02	0.01	931.61	17,974.98

* $P < 0.05$ ** $P < 0.01$

TABLE 9: Averages of the variance analysis of the 8 x 58 diallel. 1989.

F.V.	gl	AP	AF	DF	NFP	PMS	R10F	R10P	RP
CCG	7	2,114.99**	1,913.12**	156.56**	15,279.19**	0.6378*	1.1842**	478.40	30,572.38**
CCE	28	107.31	44.66	5.60**	7,173.44	0.0774	0.2525**	494.28*	11,779.10**
Error	54	60.08	37.3	1.68	4,312.91	0.0710	0.0746	265.25	4,773.33

* $P < 0.05$ ** $P < 0.01$

TABLE 10: Estimates of the effects of the general combinatorial capacity (g_i) for those variables analyzed in the 8 x 8 diallel. 1988.

Effects	AP	AF	DF	NFP	R10F	R10P	PMS	RP
g_1	-23.65^{*}	-14.43^{**}	-3.45^{**}	-10.52^{**}	-0.20^{**}	-21.17^{**}	0.12^{**}	-136.32^{**}
g_2	-16.82^{**}	-11.28^{**}	-1.61^{**}	-0.86	0.08	1.22	0.09^{**}	-47.85^{**}
g_3	-23.36^{**}	18.25^{**}	3.17^{**}	7.70^{**}	-0.31^{**}	6.53^{*}	-0.42^{**}	-59.84^{**}
g_4	14.53^{**}	1.33^{*}	0.82^{**}	-1.98	-0.06	-2.09	-0.50^{**}	20.62
g_5	-6.11^{**}	6.92^{**}	-0.65^{**}	-1.13	0.20^{**}	-17.52^{**}	0.23^{**}	-62.35^{**}
g_6	12.15^{**}	-0.17	-0.01	8.79^{**}	0.24^{**}	21.11^{**}	-0.22^{**}	164.85^{**}
g_7	11.11^{**}	19.84^{**}	2.89^{**}	0.73	0.38^{**}	21.23^{**}	0.12^{**}	157.61^{**}
g_8	-14.56^{**}	-6.92^{**}	-1.17^{**}	-2.73	0.07	3.75	0.13^{**}	4.42
DE (g_i)	**1.73**	**0.74**	**0.22**	**2.71**	**0.05**	**2.94**	**0.02**	**22.90**

1 = 452 ASPA
2 = UCR 82-202
3 = Morada id
4 = Fonalí IV
5 = Fonalí III
6 = Aceitera
7 = Inamar
8 = UCR 82-13

TABLE 11: Estimates of the effects of the general combinatorial capacity (g_i) for those variables analyzed in the 8 x 5 diallel. 1989.

Effects	AP	AF	DF	NFP	R10F	R10P	PMS	RP
g_1	-19.40**	-11.07**	-4.61**	-5.32**	-0.15**	-2.13	-0.01	-38.50
g_2	-10.07**	-8.54**	-2.05**	2.52	-0.00	1.12	0.02	-16.63
g_3	11.99**	11.66**	2.72**	1.87	-0.10	-4.63	-0.26**	-20.36
g_4	8.90**	0.38	1.43*	1.66	0.05	-5.59	0.09	-13.24
g_5	-1.52	-4.80*	-0.39	3.26	-0.37	-4.67	0.19*	-45.23
g_6	5.33	2.95	-0.56	0.92	0.20	3.67	-0.16	66.06*
g_7	14.71**	19.91**	-5.75**	-0.81	0.46**	15.04*	-0.11	95.84**
g_8	-9.94**	-10.49**	-2.27**	-0.48	-0.10	-2.75	0.24*	-27.92
DE (g_i)	**3.78**	**2.44**	**0.86**	**3.09**	**0.18**	**8.12**	**0.16**	**39.67**

1 = 452 ASPA
2 = UCR 82-202
3 = Morada id
4 = Fonalí IV
5 = Fonalí III
6 = Aceitera
7 = Inamar
8 = UCR 82-13

contributed with negative additive genetic effects to the yield /208 and its components. The dehiscent fathers, Inamar and Aceitera, presented the highest positive values of CCG in both diallels.

If the absence of the correlation between percentages of capsule opening and yield per plant is confirmed in the field, indicated by DELGADO (2) for umbracular conditions, it would be possible to initiate, with improved likelihood of success, a plan for the improvement of the indehiscent variety via selection, starting with a base population including at least Inamar and Aceitera as varieties which provide additive genetic effects, as well as the improved indehiscent varieties detected in this study. The purpose of such a program should be to effect the simultaneous selection of the variety simultaneously exhibiting the best yield and the smallest percentage of opening. Although the values of the effects of specific combinatorial capacity are not presented, it is possible to indicate that there are many of them which are significant and positive, corresponding to those crosses showing elevated levels of heterosis.

It can be concluded that the nonadditive genetic effects were of great importance in the expression of the yield and its components, since, though all the indehiscent varieties presented negative CCG effects, specific combinations did produce hybrids of F_1 of high yield.

FINAL CONSIDERATIONS

As indicated when commenting on the mean test tables and heterotic values, it was possible in this study to detect a notable hybrid vigor in the yield, both in the comparison of the average for the crosses with the average for the fathers, as well as certain specific crosses. The best values for heterosis are found in the cross between indehiscent varieties, but the best hybrids in terms of absolute yield originated from certain combinations of the dehiscent and indehiscent type.

The heterosis and high specific combinatorial capacity of certain indehiscent hybrids indicate the feasibility of obtaining closed-capsule hybrids as productive, or more productive, than the most common commercial varieties.

[The Summary is already in English.]

BIBLIOGRAPHY /209

1. CHAUDHARI, F. P., R. H. SHAH and I. D. PATEL. 1984. Heterosis and combining ability in sesame. *Indian J. of Agric. Sci.* **54(11)**:962-966.
2. DELGADO, N. 1991. Analysis of the Diallelic Crossing of Eight Varieties of Sesame (*Sesamum indicum* L.) and Inheritance of the Indehiscence of the Fruit. Maracay, Venezuela. Faculty of Agronomy. Central University of Venezuela. Master's Thesis, p. 76.
3. DIXIT, R. K. 1976. Heterosis and inbreeding depression in sesame. *Indian J. Agric. Sci.* **46(11)**:514-517.
4. GRIFFING, R. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. *Australian J. Biological Sci.* **9**:463-493.
5. KEMPTHORNE, O., and R. W. CURNOW. 1961. The partial diallel cross. *Biometrics* **17**:229-251.
6. LANGHAM, D. C. 1946. Genetics of sesame III: "Open sesame" and mottle leaf. *J. Hered.* **37**:149-152.
7. MAZZANI, B., D. MONTILLA, N. RIVAS and G. ALLIEVI. 1981. Breeding and evaluation of F_1 hybrid cultivars of sesame in Venezuela. In: *Sesame*: Status and Improvement. Proceedings

of Experts Consultation, FAO, Rome, pp. 136-137.